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LII.—On “*Orthoceras* [*Endoceras*] *duplex*,” *Wahlenberg et auctt.*, with *Descriptions of three new Species of Endoceras from the Ordovician of Sweden and Russia contained in the British Museum (Natural History)*. By ARTHUR H. FOORD, F.G.S.

THERE are a great many specimens of *Endoceras* in the British Museum from Sweden, Northern Germany, and Russia, bearing upon their labels the well-known name of “*Orthoceras duplex*,” Wahlenberg. But on referring to the original description of that species*, which is unaccompanied by any figures, one finds that it is insufficient for purposes of strict identification, and, in point of fact, many diverse forms of *Endoceras* have consequently been united under Wahlenberg’s appellation. The essential part of his description is contained in the following passage, translated from the Latin original:—

“*Orthoceratites duplex* or *giganteus* is found in Westrogothia, and there only complete and well developed, particularly in Mount Kinnekulle. The diameter is mostly a hand’s breadth, and sometimes as much as five Parisian inches, a size of the tube surpassing that of any other univalved many-

* Nova Acta Reg. Soc. Scient. Upsaliensis, 1821, vol. viii. p. 86.
Ann. & Mag. N. Hist. Ser. 5. Vol. xx.

chambered testaceous animal which I have seen alive or dead. Its form is rather cylindrical than conical, and in addition to its great breadth it has a length of six feet and more, so that we are convinced that it surpasses in magnitude all Ammonites hitherto discovered, and that it is thus the largest of all univalved testaceous animals. Its siphuncle is mostly situated quite on the margin or on the circumference of the shell, and not quite hidden by the joints of the external shell; occupying about a third part of the entire shell. On account of its situation on the margin, the segmental partitions [septa] of the shell form very oblique rings on the surface of the siphuncle, and at the same time run outwards over its face, whence it results that the siphuncle seems as it were to consist of hoods or wrappers, set or inserted upon one another, as if it sent out processes. The outer wall of the siphuncle is entire and free from perforations, showing no point of communication between the cavity of the siphuncle and the chambers of the exterior shell."

The author then proceeds to describe the smaller *Orthoceras* lodged in the siphuncle of "*Orthoceras duplex*," from which circumstance the specific name originated. It need hardly be said that the included *Orthoceras* was introduced by accident into the capacious siphuncle of the larger one*. Judging by Wahlenberg's description, which is almost confirmed by his reference to one of Klein's figures ('Descriptiones Tubulorum Marinorum,' 1731, tab. vi. figs. 1, 2), his species was most probably *Endoceras trochleare*.

It appears that Wahlenberg's views regarding the imprisoned specimen were not shared in by some of his scientific brethren, for he observes with much naïveté that "many people interested in natural phenomena have regarded this internal *Orthoceratites* as a different species, on account of its annular form; and the inhabitants of Mount Kinnekulle well distinguish it from the common *Orthoceratites* under the name "Svecico skrufstenar" [Swedish screw-stone], a by no means inapt sobriquet for *Endoceras trochleare*.

Selecting from Wahlenberg's description of "*Orthoceras duplex*" those parts of it which are essential to a specific diagnosis, they are found to consist of two only, viz. the form of the shell, which is said to be "rather cylindrical than

* This is of course no uncommon thing. Barrande gives numerous figures of *Endoceras* and *Orthoceras* into whose siphuncles young or smaller shells belonging to those genera have been introduced after the death of the animal and the partial destruction of its shell. (See Syst. Sil. de la Bohême, vol. ii. pl. cccxxxviii. figs. 9, 11; also Pal. of New York, by James Hall, vol. i. 1847, pl. xlviii. fig. 3.)

conical," and the proportionate size of the siphuncle, "occupying about a third part of the entire shell." These two characters would obviously not be sufficient for specific distinction, and the vagueness of the original description has given rise to a number of widely differing forms being placed under one specific name, according to the interpretation, generally a very liberal one, that each author has put upon the description. To make confusion worse confounded another of Wahlenberg's species—"Orthoceras commune"—has become entangled in the nomenclature of "*O. duplex*." According to the original description of the former (Nov. Act. loc. cit. p. 85) *O. commune* is not an *Endoceras*, but an *Orthoceras*, for the siphuncle is described as of moderate thickness, "equal to nearly a tenth part of the diameter of the whole shell, taken transversely," and "is for the most part situated midway between the axis and the circumference of the shell." Hisinger*, who was the first to give figures of fossils under Wahlenberg's names "*duplex*" and "*commune*," adds very little to our knowledge of those forms, and to his brief description of the former he appends the words "an species distincta?" a somewhat significant phrase, which seems to suggest the difficulty he experienced in identifying Wahlenberg's species.

Having thus failed in obtaining the required information from the books, I explained my difficulties to Dr. Lindström, and he, with no less kindness than promptitude, caused inquiries to be made for me as to whether Wahlenberg's types of "*O. duplex*" and "*O. commune*" still existed in the museum at Upsala, where some of his types are preserved. But they could not be found, so that there is now no possibility of identifying Wahlenberg's species. Dr. Lindström informed me, moreover, that he had "searched in vain" in the "Hisinger Collection" of the Royal Museum, Stockholm, for the original specimens of "*O. duplex*" and "*O. commune*" figured by Hisinger in the 'Lethæa Svecica.'

Under these circumstances it is desirable, as Dr. Lindström has suggested to me, that Wahlenberg's names should be relinquished, and new ones imposed upon all Swedish and Russian Endocerata which have hitherto fallen under them. This task has been already partly accomplished by such able palæontologists as Dewitz and Schröder in Germany and Holm in Sweden, and, so far as I am aware, there remain now very few forms requiring emendation. The collection of Swedish specimens of *Endoceras* in the British Museum has

* 'Lethæa Svecica,' 1837, p. 23.

been greatly enriched within the last few years through the munificence of the late Mr. J. E. Lee, of Torquay, and it is principally upon this new material that the following descriptions are based. I have named the first species after the illustrious Swedish naturalist Wahlenberg.

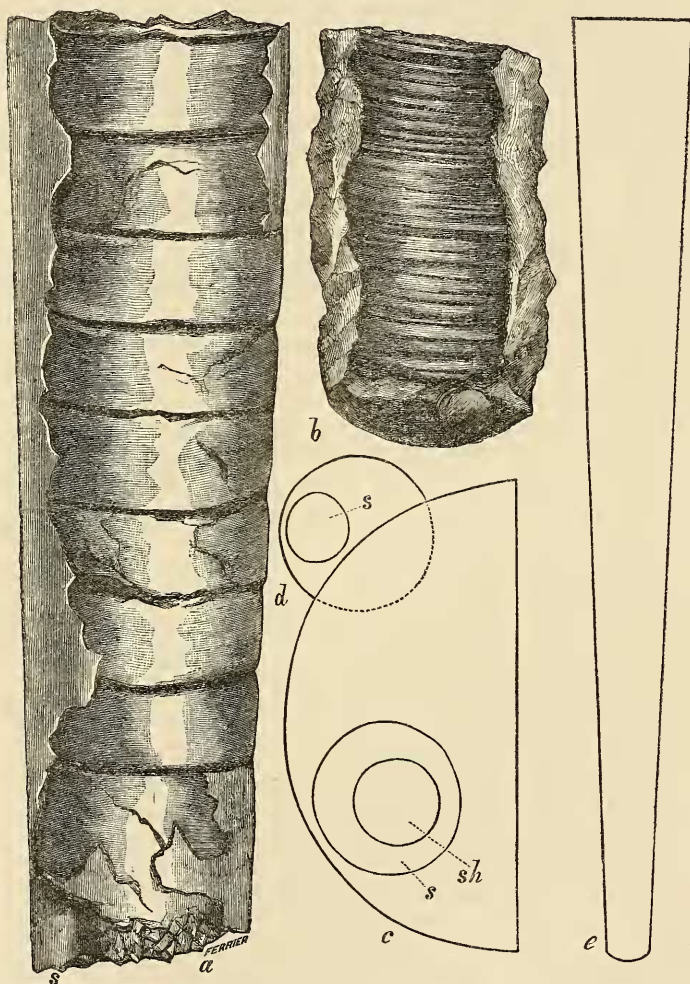
Endoceras Wahlenbergi, sp. nov.

1732. Species vi. *Orthoceratites siphone ad peripheriam posito crassiori*, &c., Breynius, *Dissertatio physica de Polythalamiiis*, p. 34, tab. iv. figs. 4-6.
1759. *Orthocerati recti*. . . in *Dahlia reperti*. De rariori quadam *Orthoceratitidis* Specie, in Suecica reperta, tractatus, &c., Nicholas de Himsel, *Phil. Trans.* vol. 1. pt. 2, p. 692, tab. xxiii. fig. A.
- ? 1775. *Orthoceratites*, Walch and Knorr, *Monumens des Catastrophes de la Terre*, tom. iii. suppl. p. 140, tab. iv e. fig. 1.
1837. *Orthoceratites duplex*, Hisinger, *Lethæa Svecica*, p. 28, tab. ix. fig. 1.
- ? 1855. *Orthoceras duplex*, Barrande, in Leonhard and Bronn's *Neues Jahrb.* p. 264, Taf. iii. figs. 11, 11*.
1857. *Orthoceras commune*, Boll, *Archiv für die Naturkunde von Mecklenburg*, p. 12, Taf. ii. figs. 4, a, b (not of Hisinger).
- ? 1861. *Orthoceras duplex*, Roemer, *Fossile Fauna von Sadewitz*, p. 60, pl. vii. figs. 2, a, b.
1866. *Endoceras (Orthoc.) duplex*, Barrande, *Syst. Sil. de la Bohême*, vol. ii. Texte iii. 1874, pp. 709, 713, pl. cccxxiii. fig. 9, pl. cccxxviii. figs. 9-12.
- ? 1869. *Orthoceras duplex (giganteum)*, Karsten, *Die Verstein. des Uebergangsgebirges in den Geröllen der Herzogthümer Schleswig und Holstein*, p. 49, tab. xvii. fig. 6, a, b.
- ? 1875. *Orthoceras duplex*, Mallada, *Bol. Com. Mapa Geol. España*, tomo ii. p. 24.
1876. *Orthoceras duplex*, Roemer, *Lethæa Geognostica*, Theil i. *Leth. Palæoz. Atlas*, Taf. vi. fig. 2, a, b.
1880. *Orthoceras duplex*, Angelin-Lindström, *Fragm. Silurica*, p. 1, tab. iii. figs. 9-11.
1881. *Endoceras duplex*, Schröder, *Schriften der physikalisch-ökonomischen Gesellsch. zu Königsberg*, Jahrg. xxii. Abth. i. p. 82, Taf. iii. figs. 1, A, B.
1882. *Endoceras cf. duplex*, Barrois, *Terr. anciens des Asturies et de la Galice*, p. 187, pl. iv. figs. 7, a, b, c.
1885. *Orthoceras (Endoceras) duplex*, Roemer, *Lethæa erratica*, in Dames and Kayser's *Paläontologische Abhandl.* Band ii. Heft 5, p. 38, Taf. ii. figs. 2, a, b.

Sp. char. Shell straight, very long. Tapering rather slowly at the rate of about 1 in 12, taking the average measurement of three adult specimens. Section circular. Body-chamber unknown. Septa moderately distant, that is, about 8 lines apart at a diameter of $2\frac{1}{4}$ inches, decreasing to a distance of 3 lines at a diameter of 8 lines. The distance of the septa varies considerably in different specimens, and even in different parts of the same individual. Thus in one

measured the septa are 6 lines apart at a place where the diameter is 16 lines, while they are only 4 lines distant where

Fig. 1.



Endoceras Wahlenbergi.—*a*, portion of the septate part of the shell (nearly one third of it), with some of the smooth inner shell-layer remaining, natural size (*s*, siphuncle); *b*, portion of the test of another specimen, natural size; *c*, part of section from fragment of a large specimen, showing siphuncle (*s*) and sheath (*sh*), natural size; *d*, section and siphuncle of young individual, natural size; *e*, diagram to show average rate of tapering of the species.

the diameter has increased to 19 lines. But on the whole the septa increase their distance as the individual advances in age. Siphuncle proportionately larger in the young than in the adult, as is frequently the case in the testaceous Cephalopods; that is to say, it attains to nearly half the diameter in the young shell (fig. 1, *d*), while in the adult it measures only about one third of the diameter (fig. 1, *c*). Test consisting apparently of two layers, the inner one being perfectly smooth and polished, whilst the outer, the surface of which is rarely preserved, is ornamented with transverse, irregular, slightly oblique riblets (fig. 1, *b*).

Remarks. The "*Orthoceras commune*" of Boll (not Hisinger), which I believe to be identical with *Endoceras Wahlenbergi*, is described by that author as having the "shell in well-preserved examples marked with obscure lines of growth, and in badly preserved ones these are so eroded that their sculpture can scarcely be recognized;" the latter is unfortunately the condition of most of the specimens in the National Collection.

It has been a matter of great difficulty to me to select out of the numerous and divergent forms described and figured under the name of "*Orthoceras duplex*" those whose characters harmonized sufficiently with the species I have now instituted, to justify their incorporation with it. The descriptions of "*O. duplex*" have often been based upon imperfect fragments, consisting of casts, or even of sections only, of a few of the chambers, in which the distinguishing characters are necessarily reduced to a minimum. In some instances the siphuncle only has been figured.

In such circumstances I cannot vouch for the accuracy of all the references given above. The dubious ones are indicated by a note of interrogation.

Amongst the specimens of *E. Wahlenbergi* from Westrogothia two attain a considerable size, the longest measuring 1 foot 7½ inches, the diameter at the larger end being 2½ inches and at the smaller end 10 lines. The other measures 1 foot 5 inches in length, with a diameter of 2 inches and 8 lines at the larger extremity and 14 lines at the smaller, where it is broken, the chambers being here filled with coarsely crystalline calcite (fig. 1, *a*). A marble slab from Sweden contains a section of an *Endoceras* in which a portion of the body-chamber is preserved. This individual measures 2 feet 7¼ inches in length and increases very slowly in diameter, measuring only 1 line at the apical and 1 inch at the basal extremity. On the whole it would seem to belong to a

more slender and slowly tapering species than *E. Wahlenbergi*.

It is difficult to conceive how shells of such great length and thinness of texture could have been preserved from fracture even during the lifetime of the animal. Professor Whitfield, of New York, who has had exceptional opportunities of studying the shells of *Endoceras* in the rich deposits of the Trenton Limestone, as well as in the splendid collections preserved in the American Museum of Natural History, affirms that he finds them "nearly always in a fragmentary condition, the earlier parts having been broken away or otherwise destroyed;" and he supposes that the sheaths formed within the siphuncle served to protect that part of the body of the animal which extended back into it in a "long finger-like projection." The sheaths, he adds, "were not only formed in case of accidents already having taken place, but were probably often formed to guard against future troubles; consequently we sometimes find them crowded together, so as to leave not more than an inch or so between them, and the intervening space filled with coarsely crystalline calc-spar, showing that the one below had not been injured so as to admit the access of foreign matter, which is always sure to be the case where injury has occurred to the individual sheath below the cavity so filled."

With reference to the number and disposition of the sheaths Professor Whitfield observes that in the American species he can "find no regularity whatever in the distances at which they occur even in the same individual. They often occur quite close together, sometimes three or four of them being ensheathed within each other; and others again will have from 10 to 20 inches between them; and I have seen examples of the shell from 2 to 4 feet long without a trace of a sheath" *.

This species resembles in some respects, as in the distance of the septa, and the proportionate size of the siphuncle, *Endoceras belemnitifforme*, Holm (Paläont. Abhandl. 1885, Bd. 3, Heft i. p. 5); but in the latter the septa are said to be equally distant from the very commencement of the shell, which is not the case with the present species, in which the septa are much closer together in the apical portion of the shell than they are at later stages of its growth.

The rare preservation of the apical end of these long and finely pointed shells will always make any characters founded upon the form of the apex but seldom available for purposes

* Bull. American Mus. Nat. Hist. no. 1, New York, Dec. 23, 1881, p. 20.

of specific distinction; and even when the apex is fortunately preserved, as in Holm's species, I hold that such structures, connected as they admittedly are with embryonic development, have too wide an import to be employed in such a way.

Horizon. *Orthoceras*-Limestone (= Arenig *).

Localities. Uitby, near Lake Siljan, and Kinnekulle Hill (Westrogothia), Sweden; Reval (Esthonia), Russia.

Orthoceras kinnekullense, sp. nov.

Sp. char. Shell elongate, tapering at the rate of 1 in 9. Cylindrical in cross-section. The septa direct, distant about $\frac{1}{3}$ the diameter, strongly arched, their convexity about $\frac{2}{3}$ that of their diameter. Siphuncle a little eccentric, about 3 lines in diameter where the shell has a diameter of 21 lines. Test ornamented with regular, direct, flattened, transverse riblets, divided by narrow interspaces. Body-chamber unknown.

Remarks. The most characteristic feature in the present species is the sculpture of the test, which is beautifully preserved on most of the specimens that have come before me. The figure (2, *b*) will enable the reader to realize the sculpture of the shell much better than a verbal description can do. It is necessary, however, to state that the riblets vary in width, so that in some places nearly five of them are contained in the space of 1 line, while in others, especially at the larger extremity of the shell, only about two and a half are required to fill that space. Ordinarily about four to four and a half are contained in one line. These measurements include the interspaces. It will be understood from this that the ornamentation of the test is visible to the naked eye.

The dimensions of the largest specimen in the national collection (fig. 2) are as follows:—length 11 inches, greatest diameter 2 inches, least diameter 1 inch. Septa about $\frac{1}{2}$ inch apart, but becoming a little closer near the smaller extremity of the shell.

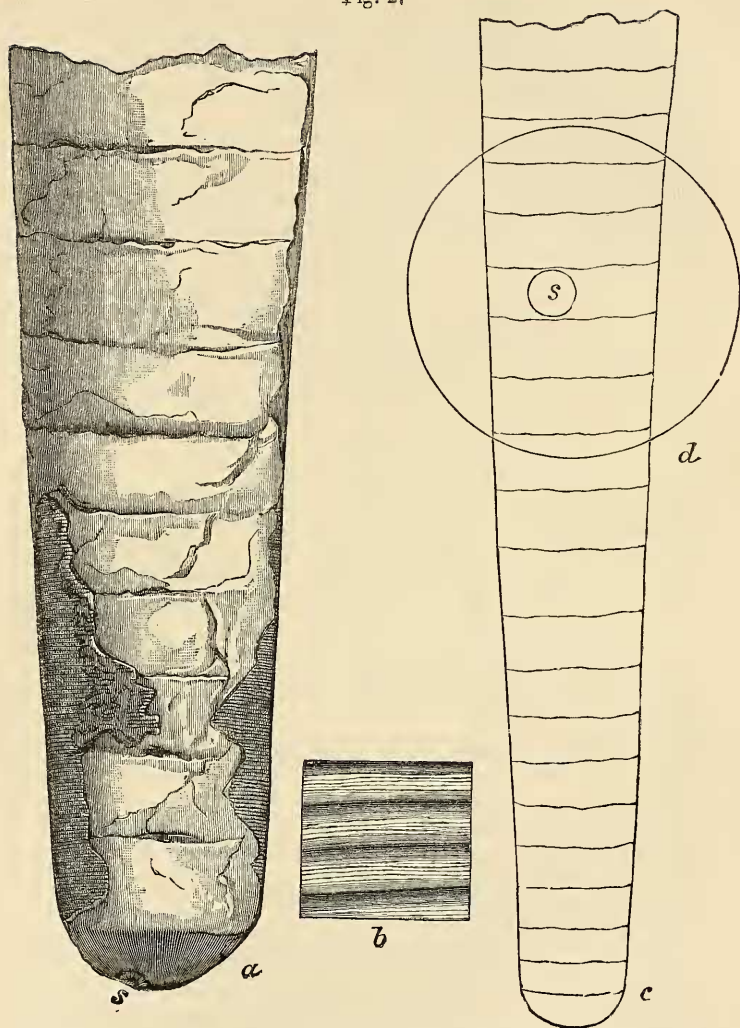
The very characteristic ornamentation of this species separates it from all other Ordovician species known to me.

Horizon. *Orthoceras*-Limestone (= Arenig).

Localities. Kinnekulle Hill (Westrogothia), and Oeland, Sweden.

* See a valuable paper by Prof. F. Schmidt, of St. Petersburg, "On the Silurian (and Cambrian) Strata of the Baltic Provinces of Russia, as compared with those of Scandinavia and the British Isles," in Quart. Journ. Geol. Soc. vol. xxxviii. p. 514 (1882); also J. E. Marr, 'On the Classification of the Cambrian and Silurian Rocks,' pp. 74 and 82 (1883).

Fig. 2.



Orthoceras kinnekullense.—*a*, fragment of the septate part of the shell (about one half of it), with some of the test remaining, natural size (*s*, siphuncle); *b*, portion of the test, greatly enlarged; *c*, outline of the entire specimen reduced one half; *d*, outline of section, restored from another specimen, showing siphuncle at *s*.

Orthoceras revalense, sp. nov.

Sp. char. Shell straight. Section elliptical, the ratio of

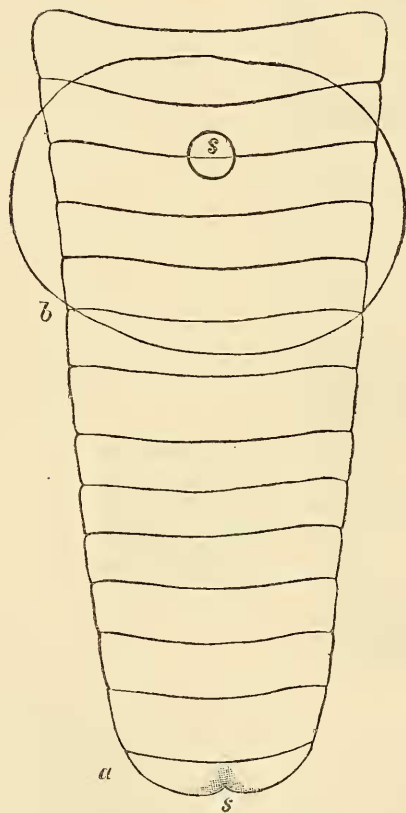
the diameters being as 24 : 19. Very uniformly tapering at the rate of 1 in 6. Septa direct, undulating; distant about $\frac{1}{5}$ the diameter. Siphuncle eccentric, cylindrical, its diameter about $\frac{1}{8}$ the longer diameter of the shell. Body-chamber and test unknown.

Remarks. The distinguishing feature of this species (fig. 3) is its relatively high rate of tapering.

Horizon. *Orthoceras*-Limestone (=Arenig-Llanvirn).

Locality. Reval (Esthonia), Russia.

Fig. 3.



Orthoceras revalense.—*a*, part of a specimen, the whole of which measures $7\frac{1}{2}$ inches (*s*, siphuncle); *b*, section, showing siphuncle at *s*. Natural size.